

7 Mcase

ALCOHOL:
ITS MORAL,
PHYSICAL,
AND
SOCIAL EFFECTS:
*(Being a Lecture addressed to the Members of St. George's
Church Parochial Guild.)*

PATRICK HEHIR, M.D., F.R.C.S.E.,

*Lecturer on Hygiene, Hyderabad Medical School, and
J. H. Nixon's Regular Professor.*

SECOND EDITION,
(REVISED AND ENLARGED.)

Madras:
LAWRENCE ASYLUM PRESS, MOUNT ROAD.

1891.

P R E F A C E .

WHEN the First Edition of this *brochure* was published, I did not anticipate that it would have attained the popularity it appears to have done. The demand for this little book having been greater than the number of copies originally printed, I have been induced to publish a Second Edition after revising and enlarging the text, and improving its form generally. I cannot really state that I was influenced to place it before the Public as a “teetotal text-book,” but if it has in the least degree reduced the baneful effects of intemperance, I shall feel that my labour has been well recompensed. Whilst I am not a rabid teetotaller, it is my earnest desire to inculcate (as far as it is possible for an expression of opinion to do so) a principle of Temperance.

HYDERABAD,

Deccan,
August,

P. H.

PREFACE TO THE FIRST EDITION.

THE following pages formed the substance of a lecture addressed to the members of the St. George's Church Parochial Guild. Many friends have been generous enough to consider them worthy of reproduction in pamphlet form. In sending the manuscript to the press, I yield to the wishes of these kind people, and not to any conception on my part of its merits,—technical or literary.

CONTENTS.

	PAGE.
CHEMISTRY OF ALCOHOL	5
PERCENTAGE OF ALCOHOL IN BEVERAGES	7
PHYSIOLOGICAL ACTION OF ALCOHOL	11
EFFECTS ON THE STOMACH	13
EFFECTS ON THE CIRCULATION	16
EFFECTS ON THE NERVOUS SYSTEM	19
EFFECTS ON THE CONTRACTILITY OF MUSCLES	23
EFFECTS ON THE TEMPERATURE OF THE BODY	24
IS ALCOHOL A FOOD ?	26
DISEASES PRODUCED BY ALCOHOL	29
UNIVERSAL USE OF NERVOUS STIMULANTS	34
ALCOHOL IN DISEASE	36
EFFECTS OF ALCOHOL ON VEGETABLE CELL-LIFE.	37
STAGES OF ALCOHOLIC INTOXICATION	38
MORAL EFFECTS OF ALCOHOL	41
EFFECTS ON MENTAL POWER	44
ALCOHOL VERY OFTEN ENGENDERS A PROGRESSIVE APPETITE FOR ITSELF.	55
HEREDITY IN RELATION TO ALCOHOL	55
EFFECTS ON LONGEVITY	57

ALCOHOL:

ITS MORAL, PHYSICAL, AND SOCIAL EFFECTS.

AMONGST subjects which engross the attention of all who are interested in the progress of their country, and in the health and welfare of the general community, as well as that of particular individuals, there is, perhaps, not one of such vital and practical importance as that of the Physical and Moral Effects of Alcohol on the Human Economy; nor is there one on which more general misconception is abroad. Much has been said and written on Temperance and Total Abstinence, and various are the opinions held regarding them. Strong feelings and prejudices are brought out in discussing their advantages. It is therefore with some hesitation, and a recognition of my limited experience in the matter, that I make this endeavour to place before the reader, in a popular form, a few points in connection with the effects of Alcohol. I am only too conscious of the fact, that the words of a single individual can have but little influence in settling the momentous questions involved in a consideration of this subject. All our medical and physiological knowledge has hitherto done little to modify the habits of the masses of the people. We are aware of the fact that much has been effected during the last fifteen or twenty years by Total Abstinence Societies and Temperance Associations; yet strong drink is still consume

in prodigious quantities, and this, notwithstanding that many men of eminence and ability have spent the best part of their life in endeavouring to reduce its use. In a perfect country,—one which had arrived at such an ideal state of civilisation as to be governed by morality, intelligence, and a pure religion, with no artificial habits and no passions or vices,—the use of intoxicating liquors would need no check, but in our real condition many things point out the dangers which may, and do, spring from their abuse. It is a matter of extreme difficulty for a Physician to approach the question of the use and abuse of alcohol with perfect impartiality. Nevertheless, as I entertain no bigotted sentiments with regard to the Total Abstinence question, I hope to be able to point out, without any considerable bias, the facts in connection with both it and temperance, leaving the decision as to their advantages or disadvantages to those who deem these pages deserving of perusal. It is not my intention to ally myself to either the advocates or adversaries of total abstinence, notwithstanding that I fully appreciate the great moral importance of the Teetotal question.

Such a universal and overwhelming evil as that of alcoholic abuse is scarcely to be conquered by a dogma. This fact leads one to consider that an intelligent comprehension of the action of alcohol on the system will have some influence, with thoughtful people, in promoting temperance, and

may tend to strengthen the social and moral arguments in favour of both temperance and total abstinence. The case of the total abstainer has scarcely been fully and unequivocally made out ; and whilst the evils of habitual drunkenness are universally acknowledged, those of the moderate drinker are not so susceptible of demonstration. Were it possible to show that the effects of alcohol on the human body, from first to last, in the smallest as well as in the largest quantities, are injurious and inconsistent with perfect health and prolonged life, the evidence would be tolerably distinct ; but the ground is not so clear—such logical proof is wanting.

I fear that some of the statements I am about to make will cause many (especially enthusiastic total abstainers) to consider me guilty of heresy. In justice to myself, however, I would remark that I am not entirely responsible for these statements, as they have been advocated by some of the highest authorities who have worked in connection with the subject of the use and abuse of alcoholic beverages. Teetotallers can adduce arguments of great weight in favour of their plea, but their cause is not invigorated by sweeping assertions and dogmatic statements, and particularly is this the case when they come to discuss the subject of alcoholic beverages consumed within the social limits of harmfulness. We would not enhance the cause of total abstinence by being illogical. We do not wish to make out a “strong case”, while we would rest satisfied

with a true one. Let us, therefore, be guided in our opinion by making a few remarks on both sides of the question.

The question of the moral and physical effects of alcohol was tersely propounded by Cardinal Manning in a series of interrogations which are here given:—

“1. Is there any vice in the United Kingdom that slays at least 60,000 or, as others believe and affirm, 120,000 (human beings) every year? 2. Or, that lays the seeds of a whole harvest of diseases of the most fatal kind, and renders all other lighter diseases more acute and, perhaps, even more fatal in the end? 3. Or, that causes, at the least, one-third of all the madness confined in our asylums? 4. Or, that prompts, directly or indirectly, seventy-five per cent. of all crime? 5. Or, that produces an unseen and secret world of all kinds of moral evil and of personal degradation which no police court ever knows and which no human eye can ever reach? 6. Or, that, in the midst of our immense and multiplying wealth, produces, not poverty which is honourable, but pauperism which is a degradation to a civilized people? 7. Or, that ruins men of every class and condition of life, from the highest to the lowest, men of every degree of culture and of education, of every honourable profession, public officials, military and naval officers and men, railway and household servants; and what is worse than all, that ruins women of every class from the most rude to the most refined? 8. Or, that above all other evils is the most potent cause of destruction to the domestic life of all classes? 9. Or, that has already wrecked, and is continually wrecking, the homes of our agricultural and factory workmen? 10. Or, that has already been found to paralyse the productiveness of our industries in comparison with other countries, especially the United States? 11. Or, that, as we are officially informed, renders our commercial seamen less trustworthy on board ship?”*

* See *Fortnightly Review* for September, 1886.

In presenting the subject for the reader's consideration, I would ask him to permit me to make use of such facts in elementary chemistry and physiology as are necessary to elucidate the text, and to allow me to begin by making a few observations on the Chemistry of Alcohol.

CHEMISTRY OF ALCOHOL.

There are many varieties of alcohol, but the one in which we have most interest is called *Ethyllic Alcohol*. Almost all the intoxicating drinks used by human beings depend, for their special properties, on the quantity of this agent which they contain. The first question that strikes us then is,—What is alcohol? When any substance containing sugar, such as fruit juice, is caused to ferment, the elements—hydrogen, carbon, and oxygen—of which sugar is composed re-arrange themselves so as to form carbonic acid, alcohol, and certain other bodies. The carbonic acid partly evaporates and partly remains to give life and piquancy to the liquor. The alcohol is the exciting or intoxicating principle; while the other agents impart the peculiar flavour and aroma. *Wine* is the fermented juice of the grape, and *cider* that of apple juice. *Toddy* is palm wine prepared by fermentation of the sugar of the cocoa-nut palm. As we have said, the alcohol is associated in many cases with other bodies, called *Ethers*, which are likewise intoxicating. In beverages, the alcohol is usually diluted

with water, and, as we have inferred, it is combined or mixed with some substances which give it colour, taste, and smell, with some which are nutritious, such as sugar and starchy bodies, and with others which have peculiar chemical properties. The amount of alcohol in beverages varies from 1 in 70 to 1 in 2 parts, yet distillation is capable of removing it from all alike.

Pure alcohol, as obtained by the chemist by distillation, is a colourless, volatile liquid, with a faint pleasant odour and but little taste. It is lighter in weight than water, its specific gravity being $\cdot 796$. A few drops placed on the hand evaporates, producing a slight tingling and a sensation of cold. It burns with a colourless flame. It has great affinity for water; and it is on account of this property, and of its power of preventing putrefaction, that strong spirit is used to preserve animal and vegetable bodies and tissues, such as fruits, and preparations in museum jars. Alcohol very rapidly abstracts the water from anything containing it with which it comes in contact. When alcohol is mixed with water, the mixture is accompanied by elevation of temperature and contraction of volume.

Chemically, ethylic alcohol is composed of three elements,—carbon, hydrogen, and oxygen,—and it is represented by the formula C_2H_5O . Other alcohols exist, differing in composition, but analogous in nature, to the Ethylic. One example

of these is *methylic* alcohol, which constitutes the greater part of methylated spirits; another is *amylic* alcohol or fusel oil, which constitutes an impurity in whisky.* They are all more deleterious than ethylic alcohol, and have special poisonous properties. Beside ethylic alcohol, intoxicating liquors usually contain some colouring matter and saline bodies. Alcohol, when first distilled, contains amylic alcohol (fusel oil), succinic acid, and glycerine, the former of which is removed by the absorbent power of charcoal. In a general way, we may say that *spirits*, such as *brandy*, *whisky*, and *gin*, if pure, contain no starch and very little sugar; *rum* contains an excess of sugar; *wines*, chiefly saccharine matter, saline bodies with ether and essential oils. Ale, stout, and porter contain much starchy and extractive matter.

PERCENTAGE OF ALCOHOL IN BEVERAGES.

The amount of alcohol in liquors and beverages forms one of the most practical parts of our subject. The *average* percentage of alcohol in ordinary beverages is as follows:—

Whisky. . . . }	50 to 60	Port Wine.	
Brandy }		Strongest. . . .	25
Rum	60 to 77	Ordinary	23
Gin	49 to 60	Weakest	16 to 5
		Madeira	16 to 5

* The deleterious effects of young and poor whisky is due to the presence of fusel oil (or potato spirit), which, in small quantities, has a pleasant odour, but a suffocating smell when strong. It rapidly produces intoxication, gastric disturbance, and headache.

<i>Sherry.</i>		<i>Claret.</i>	
Strongest. . . .	25	Strong Bordeaux . .	17
Weakest	16	Mean	15
Burgundy	10 to 14	Vin Ordinaire . . .	8 or 9
		Champagne	5 to 13
		Hock	9 to 12
<i>Ale.</i>		Sauterne	14
Stout	4 to 7	Cider	5 to 10
Porter			

These are approximate estimates only, for the quantity in some wines or beers of the same name differs widely. It will be more to the purpose if we state how much of each beverage contains an ounce of alcohol, remembering that the largest amount of alcohol that can be taken into the healthy body in active work daily, without evident ill-effects, is, according to the late Professor Parkes, $1\frac{1}{2}$ ounces. This table shows us that one ounce of alcohol would be contained in $6\frac{1}{2}$ ounces of ordinary sherry or port, in 10 to 15 ounces of claret or hock, and in 20 to 30 of ale or stout. About one pint of ordinary ale contains one ounce. Light ales and ports contain somewhat less. For $1\frac{1}{2}$ ounces of ethylic alcohol, therefore, we may reckon that about three two-ounce glasses of port or sherry, six or seven glasses of claret, and $1\frac{1}{2}$ pints of common ale, would be the maximum allowable in health in active exercise. We should bear in mind that this is the outside limit, and represents the quantity which first fails to produce any obvious diminution of physical energy in the adult healthy man. That it does not cause some deterioration

of the structure and function of the organs of the body, is another question.

The *state of combination of alcohol* in beverages is important. A pint of brandy and water of equal strength as to alcohol acts differently to a pint of ale, and there are other bodies in beers and wines which variously influence both nutrition and digestion.

It may not be out of place here to make some remarks on the special action of a few beverages. *Beer* lessens the excretion or removal of the products of tissue change ; by it less effete organic matter is got rid of ; under its influence the action of the kidneys is decreased, and less carbon is oxidised in the tissues of the body. A daily excess of beer, as is well known, leads to a state of fullness and plethora, and to an accumulation of fat. This is partly due to a check in the proper nutritive changes in the tissues, and partly to the increased supply of fat-forming substances. The waste products are imperfectly burnt off and accumulate in the system, giving rise to a gouty tendency and to bilious disorders. On the other hand, the use of beer in moderation answers several beneficial purposes in certain cases. Besides the action of alcohol, it supplies substances which are nutritious and fat-forming ; it lessens the destruction of the fat of the body and thus leads to an increase in weight. The *free*

acids and the bitter extractive matters, which are chiefly derived from the hops used in the preparation of the beverage, are useful as stomachic tonics and serve to promote digestion. The salts also assist in nutrition, though in what manner we do not know. In limited quantities, therefore, beer is undoubtedly useful to some people.

Wines, as we have said, vary greatly in their composition, so widely, indeed, that it would serve no useful purpose even to give the average composition of any one description of fermented grape juice of wine. Wines undergo important chemical changes by keeping.

Red wines contain a good deal of tannin, derived from the grape skins. This is in great part precipitated together with some colouring matter, and the cream of tartar is also gradually thrown down. Some of the sugar undergoes complex chemical changes, and with alcohol form ethers which give *bouquet* to the wine. Part of the alcohol is lost by gradual evaporation. Hence old "dry" wine is much less rich in sugar and alcohol, and contains less astringent and saline matters than young and fruity wine, but it contains more ethers.

Sparkling wines are fermented so as to contain the carbonic acid gas in solution. Although the chemical constitution of the alcohol in wines is the same as that in *spirits*, there can

be no doubt that its action is very different in the two cases. Tissue and organic degenerations are much less rapidly produced under the action of wines. The vegetable salts contained in wine, especially in the natural red light wines, in certain instances serve a very useful purpose. According to Dr. Parkes, they are highly "antiscorbutic," that is, they prevent the occurrence of scurvy.

The *ethers* have peculiar stimulating qualities, which are rapidly manifested, and are believed to promote the functions of the pancreas (which is one of the organs that manufactures a digestive fluid which specially acts upon fat).

A great deal of the difference in the *digestibility of wines* depends upon the quantity of sugar, *free acids*, and *acid salts* in them. The tannin also has a peculiar astringent effect, which sometimes assists, and at others deranges, digestion.

PHYSIOLOGICAL ACTION OF ALCOHOL.

By the physiological action of alcohol we mean its action on the body in a state of health—the manner in which it modifies those physical and chemical phenomena, the sum of which constitutes Life, such as the circulation of the blood, digestion, locomotion, sensation, and other functions of the nervous system. And here we can but very briefly deal with

the more important effects which are observed. Let any one who knows how many and various are the natural actions which go on in the body, consider what a multitude of effects such an agent as alcohol might produce in different doses, and he will have some idea as to the complexity of the subject.

The effect of alcohol differs as it is given in a small dose, a repetition of small doses, or a single large dose. Alcohol is said to be a *stimulant*. Now stimulants are such agents as cause an increased discharge of the functions, either by placing at disposal a reserve of energy already existing but inaccessible to the will, or by generating energy in its own splitting up or decomposition. They cause an increase of our vital powers for the time being, and thus give us a feeling of strength.

It has been claimed for alcohol that as it possesses all these properties, that it is both a stimulant and a food. It is stated by some that certain doses of it produce certain desirable effects, and that it is only when these particular quantities are exceeded that it acts as a narcotic. As a stimulant it is said to increase the digestive capacity, brighten the consciousness of muscular energy, to bring about a more rapid action of the heart, quicker and deeper respiration, and consequently a greater pleasure in living. We will see, later on, that but few of these remarks in favour of alcohol can be logically substantiated.

EFFECTS ON THE STOMACH.

When alcohol is taken in any form into the stomach, it is absorbed by minute blood vessels, called *capillaries*, which ramify in its structure. Thence it follows the course of the circulation. It gets into the larger vessels or veins, and is conveyed to the heart. It is *then* sent on by the right side of the heart into the lungs, in which it passes through a network of capillary vessels in contact with the air. It now passes to the left side of the heart, which sends it into all the *arteries* of the body. But all the blood which goes from the stomach to the heart passes first through the liver, which is interposed as a sort of filter between the stomach and the heart. Let us pause to explain this. The minute vessels of the stomach unite into one vein, which joins the veins from the bowels and spleen to form a larger vein, and when this larger vein reaches the liver, it breaks up again into an infinity of smaller vessels, which branch through that organ and join once more to give rise to three or four large vessels, which unite with the inferior *vena cava* to carry the blood (with whatever we drink) to the right side of the heart. It is obvious that the alcohol we take, after becoming diluted with water, is taken up by the blood, carried to the liver, thence it passes to the heart, to the lungs, back to the heart again, and finally, is distributed to all parts of the body. All this takes but a very short time. The general effects are therefore rapidly produced.

The absorption from the stomach continues so long as any more alcohol is present, but its rate of absorption is modified by various conditions.

Alcohol as such cannot be taken up directly by the vessels. It is first diluted with water in order to be able to pass through their walls. Now, when we take anything, especially solid food, into the stomach, one of the first effects is to produce fullness of the blood-vessels of the lining (or mucous) membrane of that organ, and then from this membrane is poured out a fluid which mixes with the food taken and "digests" it, that is, fits it for absorption. Alcohol in small quantities increases the secretion and movements of the stomach, and thus may aid digestion. It is *unnecessary in health*, although it may be useful in certain forms of debility and exhaustion. In large doses it impairs digestion by over-irritating the stomach, and it may produce death reflexly by shock (Lauder Brunton). The mucous membrane is provided with many little organs, called glands, which are engaged in making various substances that act chemically upon the food, and are mingled with the watery fluid poured out by the vessels. The quantity and quality of these constituents of the *gastric juice* or digesting fluid are beautifully regulated in their supply by the nature of the substance taken into the stomach. If nothing but a liquid, such as wine or brandy, is taken, very little fluid is poured out. This fluid

mixes with the wine, and when properly diluted, the combined liquid is taken up by the blood vessels. But if we take wine with our food, the solid food is mixed with it and a much larger quantity of fluid is poured out by the walls of the stomach, into its own cavity, owing to the presence of the food, so that the absorption of the wine is more gradual in consequence of its greater dilution. If we could look into the stomach just after taking a glass of wine, we should see that its inner surface becomes bright red when the wine touches it. The same would be the case if a piece of meat were taken, but the colour would probably be less intense, and less rapidly produced. We shall see that this effect of alcohol on the human body is one which is very widespread, so far as it acts merely as an irritant by coming in contact with the tissues; but when it passes into the blood, it produces a similar effect in a different way.

The *manner of combination of the alcohol* also makes a considerable difference in the rapidity of its absorption. In the form of spirits and water, it is more readily diffused into the blood and acts most rapidly. Wine and malt liquors do not act with the same degree of alacrity. One apparent exception must be noticed. If a considerable quantity of any raw spirits is taken, no effect whatever may be observed for some little time. Many cases are on record where men, for a wager, or in a drunken frolic, have swallowed a whole bottle

of spirits in one draught. The effect may be, and often is, sudden death ; but it occasionally occurs that for a quarter or half an hour, nothing happens, then sudden unconsciousness, going on to a condition of stupor sets in, followed speedily by death. This peculiarity with regard to tardy assimilation seems to be due to "a sort of paralysis of the stomach, which organ takes some time to recover its natural function of absorption."

EFFECTS ON THE CIRCULATION.

If a sufficient quantity of alcohol is taken, we see a more marked effect than we have related in connection with the stomach. The face flushes, there is a sense of being warmer. How is this explained? We know that all parts of the body are abundantly supplied with blood vessels, the smallest of which, the capillaries, pervade the skin, and form a luxurious network in almost all textures. Every beat of the heart drives blood through this network of minute vessels. The quantity of blood thus supplied depends partly upon the frequency of the pulse. But the arteries, or vessels, which carry the blood from the heart to the capillaries, are not rigid tubes; they are elastic and muscular, and can alter their size in accordance with the needs of the part they supply. Alcohol has a very marked power of thus causing the vessels to dilate whenever it is contained in the blood, so that under this circumstance

the minute vessels become turgid and the tissue redder. At the same time, it also acts upon the heart. The contraction of the heart has naturally to overcome the resistance of the vessels, so as to keep up, in them, a certain degree of fullness. When the vessels dilate, they offer less resistance to the heart, and, moreover, the whole mass of blood in them is of necessity greater. Now, to keep the arteries full, the heart must send more blood at each beat, or the pulse-beats must follow one another more quickly. But alcohol acts also on the heart itself and makes it beat quicker. The result is that it propels more blood in a given time. Thus we see that one early result of alcohol is to produce dilatation of the blood vessels, both local and general, and to quicken the action of the heart, and make it do more work in a given time. This latter action has been carefully studied by experiment. We may quote here the remarks of the late Dr. PARKES, who made many careful observations on this point. "Alcohol," he says, "in healthy persons, at first increases the force and quickness of the heart's action. In a healthy man I found that brandy augmented the rapidity of the pulse 13 per cent., and the force was also increased. Taking the usual estimate of the heart's work, its daily excess of work from the use of from 4 to 8 fluid ounces of absolute alcohol was equal to 15 tons lifted one foot. With claret the results were almost identical." Dr. Parkes adds the important statement that the period of rest of the heart was shortened, and its nutrition must, therefore, have been interfered

with. Dr. Newel Martin (*New York Medical Journal*, January, 1888,) summarised the direct action of ethylic alcohol upon the heart as follows. In non-tonic doses no quickening of the pulse occurred ; blood containing $\frac{1}{4}$ per cent. when introduced into the heart lessened materially the amount of work done ; the higher the percentage of alcohol the less the work done. The systole was imperfectly performed. He found that alcoholised blood parted less readily with its oxygen than the normal blood, and hence the tissues which suffered were partly starved of oxygen. Dr. Lauder Brunton says that when alcohol is constantly, or very frequently, present in the blood, it causes accumulation of fat and fatty degeneration of organs. Careful experiments have shown that two ounces of alcohol (an amount equivalent to that contained in the daily potations of a moderate ale or whisky drinker) increases the heart beats 6,000 times in twenty-four hours,—a degree of work represented by that of lifting a weight of seven tons to a height of one foot. Reducing this to ounces, we find that the heart is driven to do extra work, equivalent to lifting seven ounces one foot high 1,493 times each hour. No wonder that the imbibor feels a reaction—a physical languor—after the earliest effects of his indulgence have passed away ; that the heart flags and the brain and the muscles feel exhausted, and that rest and sleep are imperatively demanded. During this time of excitement the machinery of life has really been “running down.” “It is hard work,” says Dr. B. W. RICHARDSON, “to fight against

alcohol, harder than rowing, walking, wrestling, coal-heaving, or the tread-mill itself." All this is only the first effect of alcohol upon the heart. Long continued use of excess of this disturbing agent causes a degeneration of the muscular fibre, so that the heart loses its old power to drive the blood, and after a time fails to respond even to the spur of the excitant that has urged it to ruin. If this action on the heart and blood vessels occurs but once or twice, the effects are probably not of a permanent kind; but if it is kept up day after day, year after year, it leads to changes in the structure and action of the heart, regarding which we shall make some additional remarks later on. In small quantities, it seems that the action of the heart may be increased, and yet its nutrition maintained.

EFFECTS ON THE NERVOUS SYSTEM.

When conveyed by the blood, alcohol acts upon the brain, the spinal cord, and the nerves. It not only affects their function by producing quickened circulation through them, but it acts also upon their own proper structural elements. Its main effect seems to be to lower the proper activity of nervous matter.

The nervous system is composed of cells and fibres. The *cells* are situated chiefly in the brain and spinal cord, and

originate and receive nervous impulses: the *fibres* convey such impulses to and from the nerve cells. Alcohol appears to have a special affinity for the substance composing the cells and fibres which are endowed with these peculiar properties, and its effect is to diminish their activity; so that the cells originate and receive impulses more sluggishly and the fibres conduct them less perfectly. When we come to mention the effects of alcohol, as shown by the various mental and nervous symptoms which result from its misuse in the different stages of intoxication, we shall see a combination of the effects of vascular excitement and nervous weakening, and we shall be able to trace a regular course in them. We shall find that at first there is, for a time, apparent over-action or excitement of the brain and nervous system, due, in part, to increased blood supply and rapid circulation; in part, it may be, to direct stimulation of the nervous cells; but that as the effect is maintained or increased, diminished activity is the ultimate and necessary sequence. The higher functions of thought, will, and consciousness become impaired; the power of action, especially of controlled and balanced action, is lessened; sense and feeling are diminished, and at last unconsciousness and inaction result. We might trace all these effects out in detail, and see how alcohol, acting upon the brain and its various parts, upon the spinal marrow, and upon the nerves, produces these various effects, resulting from diminished activity. If *consciousness* is the faculty

of the part of the nervous system affected, this gives place first to lessened and then to lost consciousness; if *feeling*, then sensibility, it is first decreased and at length lost; if *motion*, the movements are first irregular and defective, and then more or less entirely abrogated. As a general rule, in man, at any rate, these powers or functions of the nervous system are affected in a definite order—first, the higher powers of the brain, and next those of the spinal centres flagging; and lastly, the *medulla oblongata*; and it is through paralysis of the medulla that alcohol usually causes death. The extent to which they are affected varies in different cases, and according as one or the other is affected primarily, or both are affected together, the action may show itself—first, on one or the other, or on both together, that is to say, some men will continue pretty clear-headed, even when their gait has become unsteady; in others mental derangement, such as drowsiness or excitement, speedily follows. They can take a large quantity of alcohol for some time with little perceptible effect upon the brain. Then comes a time when the power of resistance is gone, and the brain suddenly gives way, *delirium tremens* in some of its fiercest and strongest forms resulting, so that this production of unconsciousness, which is so great a safeguard against the dangerous results, cannot always be relied upon. We have seen cases of men who showed none of the ordinary signs of inebriation (or, at least, the signs were so slight as to be almost imperceptible), who became half

unconscious before they manifested any marked disturbance of equilibrium. In animals, the case is rather different. The effect of a large dose of alcohol on dogs is nearly always to produce, at first, paralysis of the hind legs, showing that the lower part of the spinal cord is in them the first to give way. The apparent immunity which drunken men enjoy from the usual effects of serious accidents, is due to paralysis of nervous mechanism, through which shock would be produced in a sober condition.

The influence, not only of *habit* and *constitution*, but of *disease* and *idiosyncrasy*, may also greatly determine the part of the nervous system which is chiefly affected. Great pain may keep up such a condition of excitement of the brain cells that the power of alcohol to produce unconsciousness is nearly lost; so, too, may mental excitement or anxiety. Probably all tissues which have vital properties may be more or less affected by alcohol, and the changes connected with their nutrition and functions may be by it impaired. The experiments hitherto made on these latter points are a little contradictory; so also are the results as to the prevention of waste and the accumulation of fat by the use of alcohol. Strong grounds are afforded by what we see in the use of alcohol in disease for the belief that it has some such action, but how it acts we hardly know as yet, and such an effect in health has been doubted, so that we need only mention these facts without discussing them.

EFFECTS ON THE CONTRACTILITY OF MUSCLES.

Dr. RICHARDSON has shown that the muscle of a frog stimulated to contract lifts a less and less weight in the presence of more and more alcohol. Dr. Parkes has likewise shown the destructive influence of alcohol upon the power of muscular exertion. He induced three soldiers to take a **march** of $20\frac{1}{2}$ miles, each carrying his full kit, weighing 51 lbs. They received either coffee, rum, or extract of meat with a little water. The experiment lasted 6 days, each man receiving one of the three fluids during two of the six days. All three men declared the alcohol to be the cause of early exhaustion, the meat extract being regarded the most valuable and sustaining for muscular work. For persons engaged in laborious work, a small quantity—that is, less than an ounce per diem of alcohol—does not appear to have much effect, but where the quantity exceeds two fluid ounces per day, the capacity for strong and sustained muscular work is manifestly **lessened** (PARKES). This effect is probably due to the dulling of the nervous system, which renders the muscles less amenable to the will, and partly to the over-excitation of the heart causing palpitation and breathlessness. Alcohol enables us to draw upon reserve energy, and may thus assist in a single effort of short duration, but it is absolutely harmful to any prolonged exertion. The trapper of North America abstains from alcohol during his day's tramp, although he frequently gets drunk in

his hut at night. Exercise has an important influence in modifying the effects of alcohol. Those following sedentary occupations and dwelling in crowded towns cannot oxidise as much alcohol as those doing out-door work, and are therefore much more susceptible to the evil effects of alcohol on the body. The Scotch gamekeeper, living and working on the Highland heath, may consume comparatively large quantities of his native whisky and still live to a ripe age—a quantity that would kill the city merchant within a few years. The Russian peasant, whilst leading his simple home life in his village, is addicted to taking “nips” of crude brandy, yet, as a soldier in the Russian Army, when on the march, he is provided with tea only.

Alcohol also exercises a deadening influence on the receptivity and delicacy of sight, hearing, and touch. Very small quantities of alcohol bring the limit of accurate vision nearer, and musical tones, separated by a minute interval, become, under alcohol, more and more confused. The sense of touch is to a like extent obscured.

EFFECTS ON THE TEMPERATURE OF BODY.

It has been affirmed by some, and denied by others, that alcohol lowers the temperature of the body. In moderate quantities it seems scarcely to affect it; in larger doses it lowers

it slightly in some cases; in poisonous doses, the body is greatly cooled. During the glow that follows the imbibition of small quantities of alcohol, there is a feeling of increased warmth, but even this is delusive and due merely to the dilatation of the surface vessels. A delicate thermometer placed under the tongue of an inebriate tells us that the temperature is below the normal.

It has been shown that during digestion of all kinds of food, the bodily warmth is slightly raised; the reverse is the case with alcohol. From half an hour to three hours after it is absorbed the temperature is lowered, and this lowering is in exact proportion to the amount of alcohol taken. It naturally follows that, contrary to popular opinion, alcoholic liquors do not fortify against cold. The habit of taking a "peg" before going out at night is the best possible way to promote chilliness of the body. It is a dangerous practice, as the suddenly dilated vessels, in contact with cold air, are made to contract, and the regurgitating cold blood is liable to set up internal inflammations. Dr. Hayes, the Arctic explorer, holds the opinion that alcohol is not only completely useless, but positively injurious to travellers in Arctic countries. He says that "strong able-bodied men become utterly incapable of resisting cold in consequence of the long continued use of alcohol." Dr. McKae said that the moment one of the men in the Arctic exploration had swallowed a

drink of spirits, it was certain that his day's work was nearly at an end, and that it was absolutely necessary to enforce total abstinence to finish the day's work.

· IS ALCOHOL A FOOD?

Various are the opinions given by authorities in reply to the question propounded in this section. The evidence of scientific investigators shows that it is a food but not a suitable one in health. Dr. Lauder Brunton compares it to sugar, which undergoes combustion in the body. But we could not live on sugar. To be more explicit, let us make use of a comparison. If we receive into the stomach a piece of bread or beef, Nature welcomes its presence. The juices of the digestive system at once take hold of it, dissolve it, and transform it for the use of the body. A million of tiny fingers (lacteals, vessels of the villi) reach out to grasp it, work it over, and carry it into the circulation. The blood bears it onwards wherever it is needed to mend or to build "the house we live in." Soon it is no longer bread or beef; it is flesh or blood or nerve of our body. Its chemical energy is imparted to us, and it becomes our strength. If, on the other hand, we take alcohol into our stomach, it receives no such welcome. Nature treats it as a poison, and seeks to rid herself of the intruder as soon as possible. The juices of the system will flow from every pore to dilute and weaken it, and to prevent its

shrivelling up the delicate membranes with which it comes into contact. All the organs of elimination, the scavengers of the body, especially the lungs, kidneys, the perspiration glands, at once set to work to throw off the enemy. So surely is this the case, that the breath of a person who has drunk only a single glass of the lightest beer will betray the fact that alcohol thus eliminated is in part unchanged. Nature apparently makes but little effort to appropriate it. It courses everywhere through the circulation, and into the great organs, with its properties unmodified. Alcohol, then, is not like bread or beef, taken hold of, broken up by the mysterious process of digestion, and used by the body. It cannot, therefore, be regarded as an aliment or food. "Beer, wine, and spirits," said Liebig, "contain no element capable of entering into the composition of the blood or the muscular fibre." "That alcohol is incapable of forming any part of the body," remarks Cameron, "is admitted by all physiologists. It cannot be converted into brain, nerve, muscle, or blood."

What becomes of the alcohol taken into the body ? Some authorities believe that it all enters into combination with the tissues, and that after a time it is carried out of the body by the natural channels. This is to some extent an error. Only a small portion gets out of the body as alcohol: the greater part—nearly all, if the quantity is not excessive—is used up, burnt, so to speak, in the body, and thus gives some

small amount of nutriment. A very trifling quantity is carried off by the lungs and kidneys, unless a larger amount is taken than can be used up, when the excess is discharged pure.* The fact that some alcohol is eliminated by the kidneys is important as explaining its special effect in producing disease of those organs ; just as the passage of all the alcohol from the stomach through the liver explains the frequency with which disease of the latter organ is met with in drinkers.

Alcohol, as we have elsewhere inferred, checks metabolism, or the active changes which occur in the cells of organs and tissues, and in the surrounding material. In this way it is that habitual excess in alcohol, especially in small doses, leads to fatty degeneration of the organs, especially of the heart, liver, and kidneys. We cannot go further into detail upon this subject ; indeed, there is yet much obscurity upon the action of alcohol on the system. We have said enough to serve as a guide to what we shall refer to in the succeeding sections.

* The presence of alcohol in the urine is established by what is known as Anstie's test, which consists of adding to the liquid to be tested a small quantity of bichromate of potassium, and some sulphuric acid. On warming this mixture a beautiful emerald-green colour will be developed if alcohol is present. This change depends on the formation of chromic acid, which, by oxidation of the alcohol, is reduced to the emerald-green chromic oxide.

DISEASES PRODUCED BY ALCOHOL.

We shall but briefly allude to the morbid condition of the human economy produced by alcohol. The number of diseased conditions brought about by it has been variously stated by different authorities. The following are among the more important:—Dyspepsia, heart-diseases, pulmonary affections, diseases of the nervous system,—epilepsy, apoplexy, dipsomania, delirium tremens, insanity; sterility, and organic diseases of the liver and kidneys.

Dyspepsia or indigestion is one of the first manifestations of the baneful effects of alcohol. When produced by alcohol this disease is associated with a coated tongue, a capricious appetite, irregular action of the bowels—sometimes constipation, sometimes relaxation, the secretion of the kidneys varies—at one time copious and pale, and at another scanty and high coloured; sleep is irregular, the mind is irritated, there is a feeling of languor, either in rising in the morning or early in the day, together with a slight degree of sickness leading to disinclination to take breakfast. During the day the patient becomes heavy, languid, and is not himself until he takes a glass of some alcoholic liquor. With regard to the injurious effects upon the digestive tract, experiments point to the fact that alcohol coagulates and precipitates the pepsine from the gastric juice, and so puts a stop to its great

work in the process of digestion. The greed of alcohol for water causes it to imbibe fluid from the tissues and juices, and to inflame the general mucous membrane. In self-defence the stomach pours in its secretion to dilute the alcohol, after which it flows into the circulation. The habitual excess of alcohol is exceedingly bad at meal times. It causes a diminution in the natural secretion, and in its stead there is secreted a tenacious mucous which hampers digestion. Its habitual use permanently dilates the blood vessels, thickens and hardens the mucous membranes, in some cases ulcerates the surface, and finally so weakens the digestion and assimilation, that the proper supply of food cannot be appropriated. The constant irritation produced by alcohol passing through the structure of the *liver* will account for the chronic inflammatory diseases of this organ, so common in confirmed drunkards. Taken in excess by healthy persons, and even in moderation by those who suffer from constant or occasional disease of the digestive tract, the effects of alcohol on the stomach are injurious. The function of digestion is improperly performed.

The continual presence of alcohol in the circulation is attended with serious organic diseases. The vessels that principally take up alcohol are the veins that form part of the large portal vein which breaks up in the liver from their ramifications in the stomach and intestines. Thus, after the

stomach, the liver is the organ which most directly receives the influence of the alcohol ingested. It is by no means astonishing to find, therefore, that the liver of spirit-drinkers is often diseased. The malady termed *cirrhosis of the liver* (otherwise "gin-drinker's liver") is so produced. A new, hard, fibrous tissue is formed around the proper substance or parenchyma of the liver, which compresses and thereby causes a decrease in its size, and, at the same time, by compressing the veins in the liver, prevents the blood flowing through that organ. Irritation of the liver, causing its congestion and degeneration, or when the stronger forms of alcohol are consumed, especially if drunk neat, the destructive changes terminate in the production of an atrophied liver—the final stage of the cirrhosis above alluded to. Similar changes may occur in the *kidneys*.

The *heart* may be affected, both organically and functionally, by the continuous use of alcohol. The functional affection is manifested by palpitation or irregular action, and a sensation of depression and weakness. But alcohol has a definite action upon the lining membrane of the heart and its valves, and also upon its muscular fibres, culminating in irreparable and permanent damage to its structures. *Gout* is said to be due to indulgence in rich and luscious alcoholic drinks, particularly port wine. Beer is said to have the same effect. Gravel and stone in the kidneys may often be produced in like manner,

The *lungs* of drunkards are sometimes found affected with fibroid degeneration, terminating in destructive disease of those organs.

Of *nervous affections*, we find alcohol playing an important part in the production of *insanity, epilepsy, and apoplexy*—from rupture of the degeneration in the walls of the arteries, produced by the constant irritation of the alcohol circulating in the blood—and various forms of *paralysis* and softening of the brain. It is entirely responsible for the condition known as *delirium tremens*.

There is no doubt but that it produces *insanity* to a frightful extent, leaving it a dreadful inheritance to the children of drunkards. Reviewing the statistics of lunatic asylums in England, we find that alcohol is accountable for from 12 to 16 per cent. of the cases in both public and private asylums. From the 13,101 patients admitted into the various asylums during 1879, the Commissioners in Lunacy placed *intemperance* at the head of their tabulated list of causes of insanity. Of this number, 1,862 were occasioned by drink. Casper stated that one-third of the insanes coming from the lower classes in Berlin were made so by spirit-drinking.

The alienist physician draws a definite line of demarcation between the two forms of drunkenness—one, *dipsomania*, is a mental disorder, the other, *simple drunkenness*, is a vice,

The man who has what is called an irresistible and uncontrollable desire to imbibe strong drink is not differently constituted to his *confrères*; there is (at first at least) no physical alteration in his organism. The constant indulgence of this desire, however, produces changes, which generally lead the drunkard through a life of misery to an early grave. It should be remembered that habitual drunkenness is not a disease; it is a vice reformable by moral methods, at least, it is alleged to be so by many high authorities.

It is admitted by all, that a system constantly saturated with alcohol has a lessened capacity for resisting disease causes, and when such a body is attacked by disease, it renders the prognosis less favourable than in other cases. The Surgeon dreads to operate on such patients, the Physician's anxiety is always aroused when he has to treat these cases. We have not the least hesitation in declaring that the habit of indulging in alcoholic liquors, exercises a supremely momentous influence in the promotion of premature death. In the record of the Registrar-General of England, *alcoholism* is credited with ten times as many deaths as "privation." There can be no doubt but that in the tropics the more potent forms of alcoholic drinks are specially injurious.

It is a remarkable fact that the official returns show that the mortality of grocers in England was at every group of ages

much higher in the year 1871, after they had begun to retail spirits than it was in 1860-61.* Of course, much of the disease from which drunkards suffer is due to the exposure and privation to which they subject themselves.

UNIVERSAL USE OF NERVOUS STIMULANTS.

We cannot too frequently repeat that alcoholic beverages taken in excess impair digestion and nutrition. Alcoholic stimulants in the shape of beer, wine, and spirits may be ingested in small quantities with advantage, especially in Northern latitudes, by healthy people. In stimulating the nervous system of the alimentary tract, they increase the powers of digestion. By the presence in the blood of the hydrocarbon of the alcohol, elements for heat generation are constantly provided, and the necessity of loading the stomach with as much hydro-carbonaceous food (fat and starches) as would otherwise be required, and by their influence in staying the destructive alterations of tissues, they reduce the quantity of food needed. Further, the stimulus afforded to the general nervous

* In 1860 an Act of Parliament was passed by which, for a license of 2*l.* 2*s.* or 3*l.* 3*s.*, according to rental, grocers or dealers in other commodities than wines and spirits might sell wine in quart or pint bottles in any quantity less than two gallons not to be consumed on the premises; previous to that year the license was 10*l.* 10*s.*, and the quantity was unrestricted. In 1860 also an Act of Parliament empowered licensed dealers in spirits (grocers among others) to take out a license, additional to the 10*l.* 10*s.* license for spirits, authorizing them to sell foreign liquors in reputed quart bottles or bottles in which the same may have been imported; while a further Act passed in 1861 allowed the sale of foreign or British spirits in any quantity not less than one reputed quart bottle. In 1872 the law compelled retailers of wines or spirits to get a magistrate's certificate prior to the grant of a license.

system satisfies a yearning for nervous stimulation, which all mankind during adult life manifest, and which may possibly be a kind of instinct. In high latitudes, this instinct is gratified by the alcoholic stimulating beverages in general use. In tropical climates, where their heat-generating properties are not required, the craving is, to some extent, satisfied by non-alcoholic stimulants—coffee, tea, tobacco, opium, dhatura, and Indian hemp. It is a strange fact that almost every race under the sun resorts to some sort of nervous stimulant, whereas the animal creation shows no such taste. The explanation may lie in the much greater use made of the higher nervous centres by man and the consequent greater exhaustion of nervous force. It is unquestionable that when taken in due quantities, they do repair the nervous energies, and thus we find throughout the world that the total abstinence from one is made up by the use of the other. Amongst ourselves, those who eschew alcohol in any form fall back upon tobacco, tea, coffee, or some other simple beverage. This universality of the use of nervous stimulants is occasionally propounded in favour of the moderate use of alcohol; but the general employment of any particular article of food or drink, or the universal indulgence in any special habit, in no way proves the food, drink, or habit to be good: it merely points to its being pleasant. If a habit is admittedly a bad one, there can be no more reason for continuing it than there can be for the indulgence in any prevalent vice.

ALCOHOL IN DISEASE.

It may be thought that we have said very little as to the use of alcohol in disease. Most people admit that alcohol is a most valuable drug, and those who have had to deal much with the abnormal conditions of the human economy, know of what immense value it is in many cases. We fully recognise the usefulness of alcohol in certain cases of weak digestion. St. Paul advised Timothy to abstain from water, and "take a little wine for his stomach's sake and his often infirmities." In the convalescent, in the weak, and the aged, we frequently find that a little alcohol with the food is very serviceable. In some cases of weak heart, in fainting from shocks of every kind, and where there is want of general tone in the body, alcohol seems to effect an improvement which no other medicine can. It is a powerful remedy in some fevers, especially in the later stages, when it reduces the temperature and calms the delirious brain.

We have mentioned some of the slighter ailments in which it is useful, but beyond this we must not go here. For, whilst alcohol may be used with great benefit, and in very large doses in some few cases of disease, the knowledge of how and when to use it with profit, is one of the points which requires all the special skill and experience of the physician, and the indications for its judicious use require technical knowledge,

which we could not here impart. It is especially in the later stages of acute diseases and fevers, and in some diseases of the nervous system and heart, that it finds its greatest use; but in such cases it is always prescribed as a medicine, in carefully measured doses, and at stated hours, and this should never be left to the discretion either of the nurse or the patient. Let it not be imagined that caprice, or educational bias, guides the doctor in giving, or withholding alcohol, in disease. There is no drug, the effects of which in abnormal conditions of the human economy, has been more minutely, thoroughly, and scientifically investigated of late years than alcohol, and a great mass of accurate knowledge as to its effects is the result; so that he who avers that the giving of alcohol is merely a matter of routine practice on the part of physicians, entirely misinterprets the position and responsibilities of medical men.

EFFECTS OF ALCOHOL ON VEGETABLE CELL LIFE.

Experiments show that alcohol, even in the most minute quantity and in the greatest state of dilution, retards the growth of vegetable cell-life. One part of alcohol in 10,000 parts of water was shown to impair the growth of water cress. For the vegetable cell, then, there is no stimulant dose of alcohol, and it is impossible to show that much the same obtains in the case of animal cell-life. For this purpose

we might take the simple *amœba*, which is a microscopical particle of undifferentiated protoplasm, endowed with all those functions, the sum of which constitutes life. This tiny bit of animal matter is capable of locomotion, assimilation, and reproduction. But any part of it can carry out one and all of these offices; there is no differentiation of function. All of these functions are at once abolished by contact with pure alcohol; and even very diluted alcohol materially interferes with their due performance. It need scarcely be said that in the developed animal each of the functions above enumerated are carried out by special organs, and are to some degree affected in a similar way to the amœba by alcohol.

STAGES OF ALCOHOLIC INTOXICATION.

We have thus far postponed the consideration of the various stages of a fit of intoxication, in order that we may see how they influence the moral aspect of our subject. During a fit of intoxication the imbibor passes through four

(1)—*The Stage of Excitement*.—The first effect of alcohol is to paralyse the nerves that lead to the extreme and minute blood-vessels, and regulate the passage of the blood through the capillary system. The vital fluid thus drawn into the nerve centres drives the machinery of life with tremendous

energy. The heart jumps like the main spring of a watch when the resistance of the wheel is removed. The blood surges through the body with increased force. Every capillary tube in the system is swollen and flushed like the reddened nose and cheek of the drunkard. In all this there is exhilaration, but no nourishment; there is animation, but no permanent power conferred on brain or muscle. Alcohol may cheer for the moment, it may set the sluggish blood in motion, start the flow of thought, and excite a temporary gaiety. "It may enable the wearied or feeble organism to do brisk work for a short time. It may make the brain briefly brilliant. It may excite muscle to quick action, but it does nothing at its own cost, fills up nothing. It has destroyed, and itself leads to destruction." Even the mental activity it has excited is an unsafe state of mind for that just poise of the mental faculties so essential to good judgment. Johnson well remarks, "Wine improves conversation by taking the edge off the understanding."

(2)—*The Stage of Muscular Weakness.*—If the action of the alcohol be still continued, the spinal cord is next affected. The control over some of the muscles is lost; those of the lower limbs usually fail first, and the staggering uncertain steps betray the result. The muscles themselves also become feebler as the power of contraction diminishes. The temperature, which for a time was slightly increased, soon begins

to fall; as the heat is radiated, the body is cooled, and the so-called "alcoholic chill" is felt.

(3)—*The Stage of Mental Weakness.*—The cerebrum is now implicated. The ideal and emotional faculties are quickened while the will is weakened. The centre of thought being overpowered, the mind is a chaos. The tongue is loosened. The judgment loses its hold on the actions. The reason gives way. The animal instincts generally assume the mastery of the man. The hidden nature comes to the surface. All the gloss of education and social restraint falls off, and the lower nature stands revealed. The coward shows himself more craven, the boaster more boastful, the bold more daring, and the cruel more brutal. The inebriate is at this period liable to become the victim of any outrage that the slightest provocation suggests.

(4)—And now we come to the *stage of unconsciousness*, in which prostration ensues, and the wild, mad revel of the drunkard ends with utter senselessness. In common speech the man is "dead drunk." Brain and spinal cord are both benumbed. Fortunately, the two nerve centres which supply the heart and the diaphragm are the slowest to be influenced; so that even in this final stage the breathing and the circulation still go on, though the other organs have stopped. Were it not for this, every person thoroughly intoxicated would die.

MORAL EFFECTS OF ALCOHOL.

We will now allude to a few more of the effects of alcohol upon the brain. We have said that alcohol appears to have a particular affinity for the cerebrum. The mind but slowly recovers from the stupor of the fourth stage of alcoholic intoxication. A sense of dulness and depression remains, to show with what difficulty the fatigued organ recovers its natural state. Some go so far as to say, that a once thoroughly intoxicated brain never fully becomes what it was before. As the habit is continued, the brain-substance become hard, its fibres and cells degenerate, and its delicate vessels lose there elasticity; the result is they fail to convey the same quantity of blood they did before. The original quantity of nourishment being lessened, there is consequently deterioration of the nervous substance—the organ of thought, and this shows itself in the enfeebled mind we so often see in a person addicted to alcoholic excess. “The habitual use of fermented liquors, even to an extent far short of what is necessary to produce intoxication, injures the body and diminishes the mental power.” The mind and body are intimately related. Any injury to one harms the other. The will is weakened by alcoholised blood. People under its influence often shock us by their want of decision. The power of self-control gradually goes. At last the drunkard is unable to resist the craving demand of his morbid appetite. Other faculties

share in his mental wreck. The intellectual perception becomes gradually less penetrating, mental decisions less reliable, the grasp of thought less vigorous. The logic grows muddy. A thriftless, reckless feeling is developed. Ere long self-respect is lost, ambition ceases to allure, the mind sinks. Parallel with this mental deterioration arises a failure of moral sense. The niceties of character lose their refinements. Broken promises point to a lowered standard of truthfulness and to a dulled sense of honour. Signs of spiritual weakness follow. Conscience is lulled to slumber. Reason is enfeebled. Customary restraints are easily thrown off. The ability to appreciate shades of right and wrong is lessened. High moral principles and motives lose their power to influence. "The judgment fools with duty." The better nature has yielded up its supremacy. The wretched victim of appetite will now gratify his tyrannical passion for drink at any extreme of deceit or crime. He becomes the blind instrument of his insane impulse, and commits acts that would formerly have made him shudder with horror. It may appear to be a mere waste of time to insist further on the evils—moral, physical, and social—of intemperance, whether it take the vulgar form of open drunkenness, or the more decent though insidious character of perpetual tipling. Dr. Baer, of Berlin, has brought forward overwhelming testimony, accumulated from almost every civilised country, to show that "crimes of violence, pauperism, &c., are in direct

proportion to the consumption of spirits, wines and beers being from this point of view comparatively harmless. On the other hand, he states that the habitual indulgence in excessive quantities of alcohol of any kind, especially between meals, though it may never be carried to the pitch of intoxication, is productive of ruinous consequences to the digestive and other functions, and it is equally certain that in health, and under properly natural conditions of existence, alcohol in any shape is not necessary." These latter effects are especially manifested if the food be taken on an empty stomach or in too concentrated a form.

A large part of the army of the unemployed Europeans and Eurasians in India owe their dependence on charity to their love for strong drink. Employers will not keep drunkards when they can get steady and reliable men for the same wages. It is undoubted that alcohol is the cause of a large amount of crime and pauperism. We all can relate instances in which drunkenness has ruined brilliant careers, where genius has been blighted, and where men have sunk into the lowest depths of degradation under continuous excesses in alcohol. We may recollect cases where the widow and her orphans have been left homeless and famishing, owing to the improvidence of a drunken husband and father. We have probably all witnessed instances in which the drunkard has manifested every phase of brutality and reckless prodigality.

We have seen the drunkard sensual, irresolute, devoid of the rudiments of conscience, and of any spark of true affection. Dr. A. W. Edis says that the premature deaths of 130,000 children in England in 1876, before attaining the age of one year, were due in a great measure to the ignorance of mothers in giving wrong food, and to the pernicious delusion of nursing mothers that they require to be kept up by alcoholic liquors. The over-lying of infants by drunken mothers is one of the most sickening of this sad list of indirect and preventable crimes. In Liverpool alone, in 1872, no fewer than 165 infants were suffocated mainly by drunken mothers. In one day Dr. Lankester held seven inquests on children smothered through the drunkenness of the mother. At an inquest held in March 1876, the Deputy Coroner for Middlesex remarked that in that district alone 300 children were suffocated annually in bed, most of them occurring on Saturday nights, the mothers coming home to bed in an intoxicated state on that night.

EFFECTS ON MENTAL POWER.

The very important question of the effect of drink in causing the *loss of mental power* must detain us a moment. Many would ascribe mental deterioration also to an organic change in the brain, but we cannot fully agree with this view. Moral character is very largely influenced by habit, by

the acquired control of the highest cerebral centres over the lower, and hence the continual impairment of that control, and the constant abolition of all power of self-restraint must, of course, aid largely in moral deterioration. In the present state of our knowledge on the subject, it is impossible for us to go beyond this; the habitual drunkard is morally defective from the beginning, and his habits point to the baser tendencies of his nature. But does the constant use of alcohol in moderate or not greatly excessive quantities bring about moral deterioration? This is an important question, and one that is difficult of answer. The proper reply appears to be, that whatever quantity of alcohol causes any temporary loss of moral control, does, if repeated, lead to moral deterioration; short of this, no such result is produced. But we must say, that of those who habitually use alcohol, even in what is regarded as moderation, a large number do, from time to time, exceed the limit of safety, and thereby weaken moral control. Dr. B. W. RICHARDSON says: "For the work that comes of the mind, no taste of alcoholic stimulation is necessary. Every such taste is a self-inflicted injury, and, what is more, an accumulating injury. The amount of alcohol which spurred the thought of to-day must be slightly increased to spur the thought of to-morrow. So, on and on the evil goes, until at last the simple, and, as it was called, the harmless dose, rises to the poisonous dose; until, with unnerved limbs, faltering memory, dulled imagination, estranged feeling, and enfeebled

reason, the victim falls. Of all men, brain-workers are least able to bear up against the ravages of alcohol. I hold that man as prematurely mad who defends the use of alcohol for himself on this ground of necessity. I hold that man as criminally mad who knowingly prescribes alcohol on this foundation. From the beginning to the end of its influence it subdues reason and sets free the passions." Alcoholic stimulants should never be taken during work, with the idea of urging the brain to greater exertions. Archdeacon Farrar, speaking from his personal experience, says that "work may be done more vigorously and with less fatigue, without wine than with it."

The effect of the use of alcohol on the mental powers, observation, memory, and judgment, &c., is exceedingly variable. There are some whose nervous system is especially prone to be affected by alcohol, others who resist its action, even in large doses, for a considerable time. The results of habitual excess are seen in many cases in a decline of intellectual power, loss of memory, and other effects; but this is chiefly when there is great excess with defective power of resistance. We are speaking now only of the permanent effects. There is no doubt that a large part of the mental deterioration which we see in chronic drinkers, is simply the result of long-continued want of exercise of the mental powers, which for their proper action require continued use.

Beyond this, there is actual decay of nerve tissue, partly from disease, partly the consequence of changes of nutritive action and of blood supply. Men have been capable of the greatest bodily and mental exertion without alcohol, and in extremes of heat and cold they are undoubtedly better without it, provided that in the latter case, at least, they have appropriate food.

As far as we have already considered the subject, we see that from the physical standpoint, the impeachment of alcohol is comparatively easy. There are few diseases that its excess may not aggravate ; there are many to which it pre-disposes, and many of which it is the *fons et origo*. We have seen that it is the cause of fatty and fibroid degeneration, many functional diseases, and several nervous affections. It has been truly termed the "genius of degeneration." As a rule, we do not find it commencing its ravages in a violent disturbance of animal economy. It begins with little maladies, trifling indispositions, one of which we notice in the languor and hebetude of the moderate drinker, who flatters himself that alcohol aids, does not retard, the functions of the body.

The connection between the abuse of alcohol and *individual morality* and *intellectuality* is likewise striking. As before remarked, the standard of both of these, in the case of the drunkard, is lowered. It is somewhat difficult to show that

the moderate drinker, who limits his beverage to a minimum of, say, an ounce of alcohol daily, is in any way affected by it. Yet it must be remembered that it is the moderate drinker who swells the list of drunkards. *No man ever yet began the use of alcohol with the fixed intention of dying a drunkard.* His backward movement in that direction has been almost imperceptible, and eventually he is lost, possibly beyond all saving.

On the highly complex cerebrum of the civilised man, alcohol slackens the rapidity with which the cell-stored impressions or memories can be recalled.

In the advanced narcotism of alcohol, the stored impressions will be gradually effaced. The first to become indistinct and vanish are the individual's experiences and acquisitions in the course of his own life; next, the common characteristics of his race; lastly, the mechanism of his heart and lungs, the final step in the series of obliterations. Let us here employ a comparison. The process of civilisation exhibits some likeness to the education of a child. Alike in their passions, the savage and the child are incapable of repressing them. They are equally wanting in self-control. Both seek the easiest gratification. The immediate yielding to an impulse is not retarded or affected by any thought of future results to themselves or others. To take a broad

view of civilisation, then, we may look upon it as the gradual development of the capacity for the postponement of an immediate pleasure, to secure the advantage of a greater one in the future; and, secondly, of the capacity of greater sacrifices of self for others and respect for the feeling of an ever-increasing number of persons. It is much the same with the education of a child. With the development of the character of the boy comes caution, or the consciousness of a future contingency, and the rejection of an inviting opportunity to obviate possible evils. His consideration for others increases; first for his relations, and next for his friends. Higher still than this in the scale of civilisation and moral education comes that recognition of evil in doing anything which impairs the rightful pleasure of any man in any act. The man who indulges in excesses in alcohol walks backward in the roads of education and civilisation. His respect for the rights and feelings of others decreases. His power of self-control is lessened. His baser passions and feelings are aroused and his sensibility blunted. In his state of semi-intoxication he becomes talkative, reveals his secrets, and weak places. He is often pugnacious, and is easily tempted beyond honour and honesty. He becomes increasingly coarse and cruel. He does not hesitate to ill-treat his family or friends; and if he goes on drinking we find that he loses the co-ordination of his own movements, and death may conclude a drunken debauch. We see then that the four stages of intoxication we

have described are all stages of de-civilisation and de-education. Each brings the man nearer the child and to the savage (Corbyn).

If it be that alcohol, from the first teaspoonful upwards, begins to initiate an ever-increasing series of degradations in the body and mind, destroying physical health, checking the course of education and civilisation, bringing the human creature closer and closer to the barbarian and brute creation, and if its effects are recognised as hereditary, how comes it that civilisation has made such progress in England? The English nation has for centuries been known as a community of drinkers, not to say as inebriates, yet we learn from history that as century follows century, the march of intellectual advancement has been uninterrupted. The answer to this important question is simple,—“The fittest survive.” Alcohol to a large extent conveys its own remedy. The survivors of a generation are the temperate and the strong. Alcohol has thinned off the weak in body, has rendered them incapable of sustaining the struggle for existence, has to a large extent removed their power of producing a progeny of inebriates, and placed them generally at a considerable disadvantage. We are of a people who have either had the will to resist the imaginary fascinations of alcohol, or who had a vital stamina capable of withstanding the degenerations which follow in the train of

alcoholic excesses. We are as it were the filtrate of men who have lived. It is often stated that thousands of people keep apparently in perfect health under the moderate use of alcohol. In reply to this, we would affirm, that a man who has never been actually drunk, might yet drink too much every day, and thereby shorten his life, weaken his health, and steal away that which is man's best possession—a healthy existence. As an excuse for the continuous use of inordinate quantities of alcohol, we sometimes hear instances quoted of great writers, great Generals, and others, who have taken their “bottle a day” for fifty years. In reply we state that these are very rare cases, and that there is scarcely one of them the truth of which is based on an unequivocal foundation. The opposite is the case. Excessive use of alcohol undoubtedly leads to premature death. It is further alleged that the effects of alcohol are lessened by the adaptation of the system to its use, that the effects are never injurious but rather beneficial up to a certain dose. The system may in exceptional cases become habituated to comparatively large doses of alcohol, especially if the consumer's occupation be a laborious one, the alcohol being oxidised in the system. In the vast majority of such cases evil results are in the end sure to follow. Man is endowed with great power of self-adaptation to altered surroundings, and with a tenacity of life under adverse conditions, he is hard to kill. But there are degrees of impairment of health and vitality long short of actual death. Man can lower the

standard of vitality and maintain that lowered standard of life. In this sense is the adaptation of the system to alcohol. The body takes a lower level of life ; it is satisfied with what health remains.

Every being begins life with a definite share of vital energy, which may be economised by the observance of the laws of health, but which, on the other hand, may be wasted. The process of adaptation to alcohol consists in the acquirement of the power to draw upon this store, in order to resist its narcotic and paralysing influence. What is withdrawn from the capital is not replaced ; it is permanently lessened. Some have even gone so far as to say that the span of existence is lessened little by little, with every ounce of alcohol taken throughout life.

Contrary to what we have just declared, it may be put forward that alcohol increases the sense of the moderate drinker's happiness, that it favours social geniality, that it diffuses the sense of well-being at the dinner party. Happiness is the sensation of health unimpaired by anxiety or want—the due fulfilment of function throughout the system. The degree of happiness is in proportion to the number and importance of the organs of the body that are carrying on their functions smoothly. The heart's action being the most important of these, there is no surer foundation for a sense

of personal comfort than a rapidly and smoothly acting cardiac muscle. There is an intimate relationship between the consciousness of pleasure and an easy working heart. It is not difficult, therefore, to explain the happiness and feelings of personal pleasure caused by alcohol. It increases warmth and functional activity. The two main sources of bodily comfort are in full activity, and all goes on well. Any anxiety of mind is narcotised out of existence. Nothing is left to impair the perfect enjoyment of life. This is but one aspect of the effects of alcohol in moderate quantities. For the other, we might inquire of the imbibor on the following morning. The effects produced on waking differ in degree only from the awaking out of the greater depths of intoxication. The prolonged dilatation of the blood-vessels in the digestive tract has caused the secretion of a thick layer of tenacious mucus to line the stomach, which hampers the assimilation of the breakfast. From the liver being too full of blood there is a sensation of heaviness. The heart beats with less vigour than it does normally ; part of its energy has been exhausted in consequence of its over-action during the previous night. The headache and general depression which follow are the results of the narcotised brain cells being charged with effete products, which the lowered circulation is unable to wash away. Between this slight general depression and the marked indisposition that follows a fit of absolute intoxication, there is no line of demarcation (Dr. J. D. Steele).

The increase of pleasure produced by alcohol is therefore delusive; it is a temporary increase of function, followed by a more than corresponding re-action. With a knowledge of all these facts, the question may be asked: Why is alcohol used at all? The answer is found in the fact that the pleasure offered by alcohol is keen and immediate; the re-action is slow and spread over a much longer period. It is employed because it creates an immediate sense of happiness and of health, and because the subsequent reaction is either not noticed at all or not associated with alcohol. The pleasurable, although somewhat evanescent sensations, created by alcoholic beverages may be considered sufficient to account for their general employment.

It may be said that as alcohol is a narcotic, may not a narcotic be occasionally needed? The reply is that alcohol impairs the brain cells not only for work, but also for reforming their own substance. Further, we cannot affect the brain cells by the action of alcohol, without affecting all the tissues and the organs of the body, *i.e.*, without lowering both the general tone and stamina.

ALCOHOL VERY OFTEN ENGENDERS A PROGRESSIVE APPETITE FOR ITSELF.

When alcohol is taken in moderate quantities for a time, it may become a necessity, and there arises a craving demand for an increased amount to produce its original effects. No food creates this constantly augmenting want. A glass of milk or water at dinner does not lead one to go on drinking day by day more and more milk or water, until milk or water, one of these two liquids becomes the great longing of existence. Yet this is too frequently the effect of alcohol. Hunger is satisfied by any nourishing food. The thirst of the drunkard is not assuaged by one draught of his accustomed liquor.

HEREDITY IN RELATION TO ALCOHOL.

It may not be out of place to make a few remarks with regard to *Heredity in Relation to Alcohol*. The alcoholic craving may be transmitted from father to son, and occasionally young persons find themselves cursed with the terrible disease known as *alcoholism*, which is a sharp abnormal appetite for intoxicating liquors that demands gratification at any cost, stamped upon their very being through the reckless indulgence of this habit on the part of one or more

of their ancestors. Sir FRANCIS GALTON says that "the world is beginning to perceive that the life of each individual is in some real sense a continuation of the lives of his ancestors. Each of us is the footing up of a double column of figures that goes back to the first pair."

We have transmitted to us from our parents our physical vigour, our features, our mental faculties, and even much of our moral character. The virtues as well as the vices of our forefathers have added to, or detracted from, the strength of our brain. The evil inclinations of our nature, which we endeavour to resist, are part of our heirlooms. Our descendants in turn will have much reason to bless their predecessors, if we hand down to them a pure, healthy, physical, mental, and moral being.

Of all agents alcohol is the most potent in establishing an heredity that exhibits itself in the destruction of mind and body. Its harmful influence was observed by the Ancients, amongst whom only *fermented* liquors were drunk.

Aristotle says, "Drunken women have children like unto themselves"; and Plutarch remarks that "One drunkard is the father of another". The drunkard by inheritance is a more helpless slave than his progenitor, and his children are more helpless still.

Nearly all the diseases springing from the use of distilled and fermented liquors are liable to become hereditary, and descend to at least three generations, unless starved out by uncompromising abstinence. But the distressing aspect of the heredity of alcohol is the transmitted craving for drink. Dr. Norman Kerr says, "This is no dream of an enthusiast, but the result of a natural law ; men and women upon whom the dread inheritance has been forced, are everywhere around us, bravely struggling to lead a sober life."

EFFECTS ON LONGEVITY.

Longevity is decidedly diminished by immoderate indulgence in alcohol. Mr. Neison's statistics show that if a man becomes intemperate at 20 years of age, he shortens his life by nearly 30 years ; he will live only $15\frac{1}{2}$ years instead of 44 ; and if at 30 by 22 years ; he will live only $13\frac{2}{3}$ years instead of 36. The effect of *moderate* quantities of alcohol on longevity is much more difficult to decide. Mr. Vivian's statistics, drawn from the records of the United Kingdom and General Provident Institution, are probably the most trustworthy on this point. He found that in the nine years, 1866—74, there were 1,110 deaths expected, according to the calculation of the Actuaries, whereas among the section of total abstainers, only 801 deaths took place ; while in the general section containing moderate drinkers, 2,002 deaths were expected and 1,977 actually

occurred. This was an advantage to the total abstainers of nearly 30 per cent. Such results as these, however, although valuable and interesting, must be accepted with a certain share of reservation because the figures are small, and other circumstances may have caused the disparity in the proportion of deaths in the two classes; and it is probable that a large portion of the alleged moderate drinkers consumed more than $1\frac{1}{2}$ ounces of alcohol per diem.

The following table and commentary is illustrative of the duration of life in various classes of the community, notably in those of Clergymen and Publicans:—

			Mean after-lifetime in years at ages from 15 to 65.				
Age.	Years.		By English	By Healthy	Of the	Of other	Of
			Life Table	Districts			
			(Males).	Life Table	Clergy.	Protestant	Publicans.
				(Males).		Ministers.	
15	43 2	47 2	38 0
25	36 1	39 9	42 1	41 6	31 3
35	29 4	32 9	33 8	33 8	25 4
45	22 8	25 7	25 7	26 0	20 0
55	16 5	18 5	18 6	17 9	14 9
65	10 8	12 0	11 9	11 4	10 3

The Table may be read thus:—At the age of 25 the mean after-lifetime of the Clergy is 42·1 years, of Publicans is 31·3 years, the difference in the two classes being nearly 11 years; thus the future lifetime of the Publican is one-fourth or 25·7 per cent. shorter than that of the Clergyman. The mean after-lifetime at age 25 is 42·1 years among the Clergy, 41·6 years among Protestant ministers, 39·9 years in the Healthy Districts among populations chiefly agricultural, 36·1 years among the whole population, and 31·3 years among Publicans. Clergymen of this age have lived 25 years, and will on an average live 42 years longer, so their mean age at death is 67 years; while Publicans of the same age live on an average only 31 years longer, and their mean age at death is 56. They lose 11 years of life. At the age of 45 the mean after-lifetime of the Clergy is 25·7 years, exactly the same as that of the populations of the Healthy Districts; it is 26·0 years among Protestant ministers, 22·8 years among the whole population, and 20·0 years among Publicans.

And now comes the all-important question as to *whether there is a safe and beneficial quantity of alcohol that may be consumed*. The reply to this question may be gleaned

NOTE.—The above calculation of the mean after-lifetime is based for the Clergy on 59,084 years of life and 1,105 deaths; for Protestant ministers on 24,944 years of life and 472 deaths; for Publicans on 228,592 years of life and 7,127 deaths. See Supplement to 35th Report, pp. clxxii--clxxv.

from what we have already said. We would forestall our conclusion, however, by at once stating our conviction that for a man in good health alcohol is unnecessary, and in most cases injurious. Regarding this point there is but little divergence of medical opinion. Alcohol in health does not impart strength. On the contrary, we have seen, that alcohol weakens the power of undergoing severe bodily and mental exertion. The moderate drinker frequently puts forward the statement that his sustained good health results from his moderate use of alcohol, or at least that this latter in no way impairs his well-being. There are thousands of so-called moderate drinkers who never take a quantity of alcohol sufficient to intoxicate them, but who are nevertheless sowing the seeds of chronic and often incurable disease. The labourer who has a drinking bout at intervals is thoroughly nauseated, and the morbid state of the liver, stomach, and brain produced necessitates abstinence for a time sufficient to bring his organs back to a normal condition; while the town-working clerk, or merchant who partakes more moderately, has his organs more or less continuously deluged with alcohol, and as a result becomes gouty, or suffers from one or more of the maladies we have already mentioned as produced by alcohol—he is prematurely old. It is possible for a man to ruin his health and bring himself to an early grave by the use of alcohol without even having been drunk in his life. There are many who put faith in the temporary and imaginary

intensification of the pleasure of existence created by the use of a moderate quantity of alcohol; to it they attribute their good appetite at the table. They believe that their mental and bodily functions are by it accelerated; that through it all the offices of the animal economy are performed with greater facility; and that therefore the enjoyment of life is correspondingly increased. They consider that by its influence they are brought into closer contact with their fellow-beings. We believe that no man can say when he has passed the line of demarcation between safety and harm. This uncertainty, together with our knowledge of the fact that alcohol is unnecessary in health, leads us to recommend total abstinence, or at least temperance, by temperance, meaning the use of not more than one ounce of absolute alcohol daily.

From our attempt to analyse the effects produced by alcohol upon man, and what we know of its action upon plants and animals, it appears that they all may be comprehended on one principle. In all it is eventually a narcotic poison to protoplasm, hindering the due performance of almost every one of its functions. Upon the highly complex and differentiated protoplasm of the body, if taken in sufficient quantities, alcohol destroys all the activity which man has in common with the lower animals and those peculiar to himself. In its action, it primarily abolishes these latter, then the former, gradually frittering them away, and at length nothing remains

but a scarcely breathing mass of animal matter. There are many facts which enable the total abstainer to defend his position. Amongst these, perhaps, the most telling are—

- (1) That in the case of disease, he has preserved a powerful and accurate remedy, which, in some instances, affords an invaluable addition to the physician's armamentarium.
- (2) The total abstainer can never become a drunkard.
- (3) His predisposition to insanity, if any exists, is reduced to a minimum.
- (4) His morality rests on a firmer basis than that of either drunkard or moderate drinker, since his animal nature is kept under control by a will unaffected by the demoralising influences of alcohol. He maintains that constant clearness and quickness of thought which is often absent in the case of the drunkard.
- (5) His children will not be degraded and vitiated, morally and physically, from birth upwards, as is the case with the drunkard's progeny.

It is admitted by most people, that with the banishment of alcohol, a vast amount of the social and moral evils of

to-day will disappear. Vice flourishes, temptation to evil has a tenfold influence, and squalor and filth cease to be baneful where alcohol predominates and rules. We have attempted to show that alcohol does not increase the power of man's work, but, on the contrary, in proportion to the quantity taken, it diminishes the vigour of both body and mind. Nor does it increase to any appreciable extent the happiness of existence or the pleasure of living, for the reaction and restitution to the normal state from its effects involve more pain than narcotism gives pleasure.

In conclusion, we would quote the following remark from the writings of Dr. Greenfield :—

- (1) In health the use of alcohol is unnecessary, and its habitual employment is liable to produce disease ; hence for most people total abstinence is the safest course.
- (2) Whenever the habitual use of an alcoholic beverage is considered indispensable, we would recommend the adoption of the following rules:—
 - (a) The quantity must be the least possible, and not more than that containing an ounce of absolute alcohol per diem,

- (b) The alcohol should always be diluted, and in a state of intimate combination with the other constituents of the liquid taken. Wines containing more than 10 *per cent.* of alcohol, should not be drunk undiluted.
 - (c) It should always be taken with meals, preferably only with dinner, never in the morning or between meals.
- (3) In such cases as those in which alcoholic beverages are used temporarily with advantage, it is difficult to lay down any definite rules as to kind and quality : but let the dangers,—moral, social, and physical,—of excess in drinking always be borne in mind and control the action in this matter
- (4) In disease, alcohol should be used only as a medicine, and under this circumstance, the quantity, quality, and time should be strictly regulated by the physician's orders. If these rules and the principles upon which they are grounded, were observed, we should not have to lament the ruin of health and constitution and the increase of vice and crime which now result from excessive drinking.

Before concluding, we would advocate that the subject of the *moral*, *physical*, and *social* aspect of the alcoholic question, should be intelligently and competently dealt with in every school.

We would offer the reader many apologies for placing the foregoing mass of facts before him in such heterogeneous and unconnected a manner, but would state in extenuation of this apparent defect that want of time has precluded the re-arrangement which it was our intention to have effected before publication. Nevertheless, we would fain hope that the data we have presented may prove sufficient to aid us in coming to a right conclusion on this very important subject.

